

climate brief

What Can Electric Companies do to Reduce CO₂ Emissions?

Global Climate Change Research Area
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While debate continues nationally and internationally about how to respond to global climate change, it is becoming clear that U.S. electric companies may need to limit their greenhouse gas (GHG) emissions. This Climate Brief describes key actions electric companies potentially can take to reduce their GHG emissions, and how these actions compare in terms of their potential yield of GHG emissions reductions. Table 1 shows estimates of the quantities of CO₂ emissions that may be avoided or reduced by applying each of these GHG reduction actions to an example 500-MW coal-fired power plant.

These actions differ in terms of their cost-effectiveness (\$/ton CO₂) to achieve GHG emissions reductions. (See the companion Climate Brief, *The Costs of Key Electric Sector Greenhouse Gas Reduction Actions*, 1011133, for information about these comparative costs.)

GHG reduction actions differ in important ways

In addition to differences in their yield of GHG emissions reductions and cost-effectiveness, GHG reduction actions differ in other key ways. Some actions, like environmental dispatch, do not require technological advancement and can be implemented now. Other actions, such as carbon capture and storage, remain unproven and may require significant R&D before they may be deployed on a large scale.

Some GHG reduction actions face substantial regulatory barriers. For example, New Source Review (NSR) may discourage companies from

Table 1. Potential GHG emissions reductions from GHG abatement actions that can be implemented by electric utilities.

GHG Emissions Reduction Actions	Quantity of CO ₂ Reductions	
	Assumptions	Tons Per Year*
On-System		
Biomass Co-Firing	5% co-firing of biomass with coal.	150,000
Generation Efficiency	2% efficiency improvement.	60,000
Environmental Dispatch	Coal plant is dispatched 10% fewer hours; gas displaces this generation.	150,000
Other Internal Efficiency	—	Generally small
Fuel Switching	Switching a plant from coal to gas.	1,500,000
Plant Retirement	Depends on emissions from replacement power.	Potentially large
Capture and Disposal	Up to 95% reductions in emissions.	2,850,000
New Generation Capacity	Depends on what is replaced and how much of the generation is needed to meet new demands.	Potentially large
Off-System		
Demand-Side Management	—	Potentially very large
Market Purchases	Subject to legislative and regulatory restrictions.	Potentially unlimited
Terrestrial Sequestration	1,000 acres of new loblolly pine might yield 100,000 tons of CO ₂ reduction over 50 years.	2,000

* Estimates are based on application to a 500-MW coal plant, a 10,000 Btu/kWh heat rate, and 6,000 hours of annual operation (resulting in approximately 3 million tons CO₂ emissions annually).

modifying existing coal-fired power plants to improve their generating efficiency. Also, electric utilities that remain subject to rate-of-return regulation may need approval from state regulators before making large capital investments to implement some GHG actions like fuel switching

or building new generation capacity.

In addition, not all of these GHG reduction options will be available or appropriate for individual electric companies. For example, carbon capture and disposal may not be feasible at a power plant located far away from potential carbon disposal sites.

On-system actions

Electric companies can consider a variety of actions to reduce GHG emissions within their own generating systems.

Biomass co-firing

An existing coal-fired facility may be modified to allow a small percentage of biomass fuel (i.e., 2-10%) to be co-fired along with the coal. This reduces the amount of coal burned to generate a given amount of electricity, effectively reducing direct CO₂ emissions. It also may reduce SO₂ and mercury emissions. Because it is relatively expensive to transport biomass fuels, biomass cofiring may be suitable only for power plants located near a steady source of biomass fuel.

Generation efficiency

By installing more efficient equipment or combustion optimization software, companies can improve the operating efficiency of their coal-fired units. This reduces the amount of fuel burned to generate a given amount of electricity, effectively reducing direct CO₂ emissions.

Other internal efficiency

When electricity is transmitted and distributed, “line losses” reduce the amount of power delivered to an end-user. By replacing existing transformers with high-efficiency transformers, companies can reduce line losses, allowing them to meet a given level of demand with less generation, reducing their GHG emissions.

Sulfur hexafluoride (SF₆) is a highly potent greenhouse gas used by electric companies. Companies can reduce SF₆ emissions by implementing effective SF₆ leak detection, repair and recycling programs.

Environmental dispatch

Companies can reduce the dispatch of existing coal-fired power plants. By burning less coal, companies can reduce their GHG emissions. However, these reductions are likely to be partially offset by increased GHG emissions associated with the generation of replacement power. The cost of environmental dispatch depends, in significant part, on the price differential between coal and other fuels.

Fuel switching/repowering

Repowering a coal-fired power plant to burn natural gas in a combined cycle turbine also may yield significant GHG emissions reductions. Because natural gas is significantly less carbon intensive than coal on a pounds CO₂ per MMBtu basis, a natural gas combined cycle plant can generate the same amount of energy as a coal-fired facility with significantly less carbon emissions. These plants also generate electricity more efficiently than coal-fired plants, resulting in less fuel being consumed per MWh generated. Both fuel switching and repowering will require companies to make substantial up-front capital investments.

Plant retirement

In some cases, companies can also consider retiring older, less efficient coal-fired power plants and replacing them with newer, more efficient facilities that use coal more efficiently or rely on less carbon-intensive fuels like natural gas. However, early retirement of existing generation assets may be very costly.

Capture and disposal

In theory, CO₂ emitted from burning fossil fuels can be captured before it is emitted into the atmosphere and disposed of by storing it for very long periods of time. Small scale experimental technologies exist today to capture carbon emissions from burning fossil fuels, but the question of what to do with vast quantities of captured CO₂ remains unanswered. A variety of potential disposal options are being studied today by EPRI and others, but many questions remain to be answered before these systems can be implemented on a large scale.

New generation capacity

Increasing the capacity of existing nuclear and hydroelectric facilities, deploying new nuclear or hydroelectric facilities, or developing new renewable generation sources—such as wind and solar power—can reduce GHG emissions if these projects displace existing generation sources that are more GHG intensive. Landfill gas to energy projects also can reduce GHG emissions by burning fugitive methane (CH₄), a powerful GHG. These

projects also may yield indirect GHG emissions reductions by displacing more carbon-intensive “grid” power.

Off-system actions

Companies also can consider actions to reduce or offset GHG emissions outside of their own generation systems.

Demand-side management

Investments in programs to increase end-use energy efficiency and reduce electric demand can yield GHG benefits. If future demand growth remains flat, less electricity will need to be generated to meet load, thus reducing GHG emissions. If electricity demand is expected to grow, new efficiency projects can help companies to meet the growing load without corresponding increases in their GHG emissions. However, it is difficult to determine the amount of GHG emissions reductions actually generated by these kinds of projects, and it may be difficult to determine who “owns” these GHG reductions.

Market purchases

Many observers believe it is likely that any future U.S. regulatory scheme to reduce GHG emissions would allow companies to buy and sell GHG emission reduction credits through an emissions trading system. By purchasing GHG credits, an electric company could offset an equal number of tons of its CO₂ emissions. Today, however, GHG trading in the U.S. is in its infancy, and its future development remains uncertain.

Terrestrial sequestration

Another promising approach that companies can use to offset their GHG emissions involves storing carbon in trees, grasses, and crops growing on forest and agricultural lands. Growing trees on sites where none have recently existed (afforestation) is an approach some electric utilities already have experimented with successfully.

References

1. EPRI, *Methods for Systematic Evaluation of Emissions Reduction Options: Managing Risks from Climate Policies*, Technical Report, 1005248, December 2003.
2. EPRI, *A Climate Contingency Roadmap: The U.S. Electric Sector and Climate Change*, Technical Update, 1009311, December 2003.